

## Herbal Medicines and Perioperative Care

THE article by Lee *et al.*<sup>1</sup> is an important addition to the anesthesia literature. Several survey studies have documented the widespread use of herbal products by patients who undergo surgery, but there are few controlled clinical trials of the efficacy or adverse effects and virtually no outcome studies of the effects of herbal medications on surgical patients. The biologic properties of several herbs can interfere with bleeding and recovery from anesthesia, but clinical data on herbal adverse effects are largely anecdotal. Lacking clinical trials, the clinician must rely on case reports and an understanding of the underlying biology of the herb.

Outcome studies of herbal products are difficult to perform for several reasons. First, it is difficult to accurately assess herbal medicine use in individual patients, even when patients are asked about usage directly, either because of their reluctance to disclose herbal use to anesthesiologists or because they do not consider many herbals significant enough to mention.<sup>2</sup> A physician understands that herbs may be therapeutic, harmless, or dangerous, but many patients assume that natural always means harmless. Therefore, it may be difficult to know which patients are taking herbal products. Studies suggest that more than 30% of the surgical population has used herbs, with higher use by patients with acquired immunodeficiency syndrome or cancer and by people residing in the Western part of the United States.<sup>3-5</sup> Second, although a physician may know the herbal medications a patient is taking, it is virtually impossible to assess the concentration of active ingredient in any herbal product. Herbal medications, which are classified under the Dietary Supplement Health and Education Act of 1994, are exempt from preclinical animal studies, controlled clinical trials, and postmarketing surveillance. Therefore, for many herbal medications, the identity of the active ingredient, the proper dose to achieve an effect, and metabolism and disposition are often unknown. One study found an order of magnitude difference in the ginsenosides, depending on the brand of ginseng.<sup>6</sup> We have also observed this variability with ginseng. Depending on how ginseng is grown and extracted, it may contain different ginsenosides.<sup>7</sup> Two of the clinically important effects of ginseng include hypoglycemia<sup>8</sup> and interference with

drugs such as coumadin,<sup>9</sup> but the extent to which these effects impact care is unknown. Finally, several of the adverse effects attributed to herbs may only become apparent perioperatively. For example, case reports and laboratory studies show that some herbs such as garlic, ginseng, and ginkgo interfere with coagulation.<sup>10</sup> However, these effects may be detected only during acute blood loss. Drug interactions with several herbs such as kava and valerian, which are mild sedatives, could be expected to potentially complicate general anesthesia.<sup>2</sup> On the other hand, many herbal products, including St. John's wort, change the metabolism of immunosuppressants and cancer chemotherapy by stimulating cytochrome P<sub>450</sub>3A4.<sup>11</sup> These effects, clinically important outside of the operating room environment, are unlikely to directly influence anesthetic care.

Despite anecdotal evidence and model populations, little is known about the outcome of patients taking or discontinuing herbal medications before anesthesia and surgery. The study by Lee *et al.*<sup>1</sup> represents one of the early attempts to objectively quantify outcome differences for patients taking herbal medicine. As such, the authors applied validated outcome methodologies to herbal medicine. The overall conclusion, that the authors could not define specific outcome changes, is encouraging.

Several caveats to this study should be highlighted. First, the study evaluated traditional Chinese medicine. There are more than 12,000 identified herbals, of which more than 500 are commonly used in China.<sup>12</sup> Chinese medicines are complex concoctions of various herbs. Such concoctions are given in therapeutic packages for a variety of disease states as well as perioperatively. Second, without standardization of the concoctions, it is difficult to know what patients are actually receiving. Finally, the study includes a large number of surgical procedures and a relatively small number of patients. Infrequent but highly important events may have been missed, as occurs in drug allergy. Some herbs, such as aristolochia (aristolochic acid), present serious but somewhat rare problems.<sup>13</sup> Despite these caveats, it seems that the magnitude of the perioperative adverse effects associated with herbal usage is relatively modest. Most of the events fall within the parameters of clinical practice, and absolute attribution to drug interaction is not possible. Based on their biologic properties, if any effect were to emerge as that of an herbal remedy, it would be coagulation, but there is only one description of a probable event, and its severity is ranked as mild.

Although this article is reassuring to clinicians and patients, we should be aware that herbs are drugs whose interactions could manifest in the perioperative period.

◆ This Editorial View accompanies the following article: Lee A, Chui PT, Aun CST, Lau, ASC, Gin T: Incidence and risk of adverse perioperative events among surgical patients taking traditional Chinese herbal medicines. ANESTHESIOLOGY 2006; 105:454-61.

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Thus, ginseng can decrease blood sugar and interfere with the action of warfarin. Hepatotoxicity with kava<sup>14,15</sup> has banned its use in Europe, where liver transplant has been necessary in more than 20 patients. Therefore, despite the reassurances of this study, it seems prudent to recommend discontinuation of most herbals before surgery. However, given the reality of modern practice in which many patients are not seen until shortly before or on the day of surgery, the results of this study are encouraging to patients and physicians.

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## Of Mice and Nematodes

WE still do not know how inhaled anesthetics work, but significant advances have been made in recent decades, as researchers have shifted from primarily biophysical models (*i.e.*, lipid perturbations) to systematic neurobiologic approaches. The goal of this enterprise, progressing in dozens of laboratories around the world, is to identify molecular targets of general anesthetics and to understand how they mediate the cellular, tissue, and behavioral effects of these drugs. In this issue of *ANESTHESIOLOGY*, Sedensky *et al.*<sup>1</sup> describe anesthetic sensitivity studies on genetically modified animals from two different phyla that suggest remarkably similar roles for one potential target, stomatin.

Stomatin is so named because a deficiency of this membrane protein in humans causes hereditary stomatocytosis, a hemolytic disorder where erythrocytes seem to have pale central areas with the shape of a smile or a fish mouth. The protein is also found in sensory neurons, where it is thought to play a role in mechanical sensation. A group of researchers at the University of California at San Francisco Medical School, wishing to create a laboratory animal model for the hematologic disease,

created a knockout mouse lacking the gene for murine stomatin.<sup>2</sup> Independently, Sedensky and Morgan's research team at Case Western Reserve Medical School (Cleveland, Ohio) mapped mutated genes in *Caenorhabditis elegans* nematodes that caused abnormal sensitivity to volatile anesthetics. A number of these mutations were in the *unc-1* gene, which encodes a homologue of stomatin, resonantly named UNC-1.<sup>3</sup> Mutations that reduce UNC-1 expression or activity result in immobilized worms at lower than normal partial pressures of diethyl ether, without altering sensitivity to halogenated agents. In their new article, Sedensky and Morgan report that stomatin knockout mice also display increased sensitivity to the immobilizing effects of diethyl ether (*i.e.*, decreased minimum alveolar concentration), but not to other volatiles. Testing whether patients with hereditary stomatocytosis also have increased sensitivity to diethyl ether is theoretically possible but ethically indefensible.

Molecular genetic techniques have proven to be powerful tools for linking putative molecular targets to anesthetic effects. In classic forward genetic studies, researchers induce random mutations in animal genes and screen viable mutants for altered anesthetic sensitivity (phenotype). Interesting mutants are analyzed by mapping the mutated gene and defining its sequence, which encodes a protein that may be an anesthetic target. Small animals with short generation times, such as *C. elegans* or fruit flies (*Drosophila*) are ideal for forward genetics, although translating anesthetic effects in humans to be-

This Editorial View accompanies the following article: Sedensky MM, Pujazon MA, Morgan PG: Tail clamp responses in stomatin knockout mice compared with mobility assays in *Caenorhabditis elegans* during exposure to diethyl ether, halothane, and isoflurane. *ANESTHESIOLOGY* 2006; 105:498-502.

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havioral screens in worms and flies is challenging. Sedensky and Morgan also identified another *C. elegans* gene that affects anesthetic sensitivity; gas-1 alters mitochondrial function and may provide insight into human mitochondrial myopathies.<sup>4</sup> C. Michael Crowder, M.D., Ph.D. (Associate Professor, Department of Anesthesiology, Washington University School of Medicine, St. Louis, MO) has also exploited *C. elegans*, identifying a number of genes that alter anesthetic sensitivity through changes in G proteins<sup>5</sup> and excitatory neurotransmitter release.<sup>6</sup>

Another approach, sometimes called reverse genetics, has been used in studies of mice. In reverse genetics, a putative target is identified based on thorough molecular studies, and then the gene for that target is selectively targeted for deletion (knockout) or mutation (knock-in). Techniques also exist for triggering knockouts after normal development (conditional knockout) and for restricting the expression of altered genes to specific regions of the nervous system. The resulting transgenic animals are then characterized for the phenotype of interest, in this case altered anesthetic sensitivity. Anesthetic-sensitive neuronal ion channels, including  $\gamma$ -aminobutyric acid receptor type A (GABA<sub>A</sub>) receptors, glutamate receptors, and background-leak potassium channels have been studied using these techniques. One particularly successful case was based on the finding that single amino acid mutations in GABA<sub>A</sub> receptor  $\beta_2$  and  $\beta_3$  subunits largely eliminate the effects of etomidate and propofol on these neurotransmitter receptors. Transgenic mice containing these mutations were found to be resistant to etomidate and propofol anesthesia, and further behavioral testing revealed specific roles for  $\beta_2$ - versus  $\beta_3$ -containing receptors in different anesthetic-sensitive behaviors.<sup>7,8</sup> Knockout mice also reveal that GABA<sub>A</sub> receptors<sup>9</sup> and background potassium channels<sup>10</sup> mediate some of the effects of volatile anesthetics. Based on molecular studies showing that nitrous oxide and xenon inhibit mammalian glutamate receptors, reverse genetic approaches were also used in *C. elegans*. Crowder and his coworkers studied nematodes lacking the homolog of the major *N*-methyl-D-aspartate-sensitive glutamate receptor subunit and found that the effects of nitrous oxide were ablated,<sup>11</sup> whereas a different glutamate receptor was required for xenon anesthesia.<sup>12</sup>

Can we expect that forward genetics in nematodes and reverse genetics in mice will converge on a conserved set of anesthetic targets that will also be relevant to humans? So far, stomatin seems to be unique in this regard. This is not too surprising, because worms express fewer genes, have a much simpler nervous system, and have a very limited repertoire of "behaviors" in comparison with vertebrates. Moreover, although mice

and humans are in the same phylum and class, genetic changes in these two mammals are not always expressed in the same way. Stomatin itself illustrates this issue, because stomatin knockout mice do not develop hemolytic anemia.<sup>2</sup>

Nonetheless, studies using simple animal models such as *C. elegans* will continue to provide information about general anesthetic mechanisms in a variety of ways. First, we have only begun to identify the proteins that are important anesthetic targets. With complete genome maps available, forward genetic screening in simple animals is a much more efficient method of identifying novel candidate targets. The alternative is functionally testing the anesthetic sensitivity of every plausible gene product that is identified. Second, lack of convergence between animal models can also be informative. For example, propofol does not anesthetize *C. elegans* (C. Michael Crowder, M.D., Ph.D., electronic personal communication, April 2006). Because *C. elegans* GABA<sub>A</sub> receptors are insensitive to propofol,<sup>13</sup> this observation bolsters the conclusion that the anesthetic acts selectively in vertebrates *via* specific GABA<sub>A</sub> receptor subtypes. Third, there are transgenic experiments that are easier to perform in worms, because their small size and simple nervous systems allow them to survive mutations that are lethal in mammals. The *C. elegans* *N*-methyl-D-aspartate receptor knockout study with nitrous oxide is an example. Knocking out the most common *N*-methyl-D-aspartate receptor subunit (NMDAR1) in mice is lethal, so testing the role of this subunit in mice may require finding a nonlethal mutation that selectively alters nitrous oxide sensitivity.

Molecular genetic experiments in nematodes and mice are in many ways complementary, because the advantages of each experimental model compensates for the weaknesses of the other. Our understanding of anesthetic mechanisms has already been tremendously enriched by experiments in both mice and worms, and future molecular genetic research on anesthetic targets in a variety of animal models should be encouraged.

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## A Century of Arginine Vasopressin Research Leading to New Therapeutic Strategies

DRS. Oliver and Schäfer<sup>1</sup> reported more than 100 yr ago that extracts of the pituitary gland had potent vasopressor effects, and this action was restricted to extracts from the posterior pituitary lobe.<sup>2</sup> Having been known only as *vasopressin* for the first 20 yr after its detection, its strong antidiuretic effects and beneficial actions in diabetes insipidus resulted in the renaming of vasopressin as *antidiuretic hormone*.<sup>3</sup> In 1951, the specific peptide fraction of posterior pituitary preparations attributed to the antidiuretic action was isolated.<sup>4</sup> The first complete synthetic preparation of the hormone by Vincent du Vigneaud *et al.*<sup>5</sup> was accomplished in 1954. These researchers received the Nobel Prize for their work 1 yr later. Until approximately 15 yr ago, vasopressin was used to treat polyuria in patients with diabetes insipidus<sup>6</sup> and to reduce blood loss in patients with gastrointestinal bleeding.<sup>7</sup> There was interest in vasopressin as a pro-peristaltic drug during the 1970s and 1980s,<sup>8</sup> but this soon diminished because of the drug's unpredictable effects.<sup>9</sup> The beneficial effects of vasopressin in shock patients was originally described in 1957 as a brief report,<sup>10</sup> but it was only in the 1990s that vasopressin was used clinically for the potent vasopressor effects it was originally described for almost 100 yr ago.

Stimulated by reports in patients with cardiac arrest<sup>11</sup>

This Editorial View accompanies the following article: Treschan TA, Peters J: The vasopressin system: Physiology and clinical strategies. *ANESTHESIOLOGY* 2006; 105:599-612.

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and vasodilatory septic shock,<sup>12</sup> the clinical use of arginine vasopressin (AVP) and its analogs as vasopressor drugs has increased substantially during the past 15 yr. In this issue of *ANESTHESIOLOGY*, Drs. Treschan and Peters give a comprehensive overview of clinical strategies for which AVP has already been successfully applied.<sup>13</sup> AVP has also been used as a supplementary vasopressor in patients with cardiogenic shock,<sup>14</sup> cardiocirculatory failure after successful cardiopulmonary resuscitation (Viktoria Mayr, M.D., Resident, Department of Anesthesiology and Critical Care Medicine, Innsbruck Medical University, Innsbruck, Austria, verbal personal communication, May 26, 2006), drug intoxication,<sup>15,16</sup> and during surgery of carcinoid tumors.<sup>17</sup> Because an anesthesiologist may face any of these pathophysiologic states, it is of paramount importance to be familiar with the physiologic and pharmacologic characteristics of AVP and its analogs.

Despite numerous reports and small studies describing the successful and potentially lifesaving effects of AVP in cardiovascular shock states seemingly incompatible with survival, the concept of AVP as a "magic bullet" must be avoided, and AVP should be used only at recommended dosages for indications that have been defined through clinical investigations. Before introducing AVP into standard treatment protocols, the results of major clinical outcome studies must be awaited. However, the difficulties of proving significant survival benefits of a rescue therapy in multicenter trials is readily apparent. Furthermore, for some indications, *e.g.*, anaphylactic shock or drug intoxications, it is unlikely that large clinical studies can ever be performed. It should also be remembered that it is unlikely that a drug used in diseases where the disturbance of homeostasis is as complex as in cardiac arrest, severe shock states, or multiple organ dysfunction syndrome will be free of side effects. The first overview of significant side effects of a supplementary AVP infu-

sion in patients with advanced vasodilatory shock has recently been presented,<sup>18</sup> but results of major studies are needed to assess the risk-to-benefit ratio of AVP in critically ill patients.

Currently, three multicenter trials evaluating the effects of AVP in cardiac arrest, septic shock, and uncontrolled hemorrhagic shock are being performed. The Vasopressin and Septic Shock Trial, a multicenter, triple-blind, randomized controlled study in intensive care units across Canada and Australia, examines the effectiveness of AVP (0.03 U/min) as a supplementary vasopressor on 28-day and 90-day survival in patients with septic shock. Finalization of patient randomization is expected soon, but initial promising results of the interim analysis have been reported. The hypothesis being tested is that compared with norepinephrine treatment alone, supplementary infusion of low-dose AVP (0.03 U/min) would increase 28-day survival from 40% to 50%. In France, an investigation studying the combination of AVP and epinephrine *versus* epinephrine alone during prehospital cardiopulmonary resuscitation is under way; 2000 patients have already been enrolled, and first results are expected in late 2006. In summer 2006, our study group will initiate a multicenter trial in Europe to analyze the effects of AVP in prehospital trauma patients with uncontrolled hemorrhagic shock who do not respond to standard treatment.<sup>19</sup>

Since its discovery more than 100 yr ago, AVP is increasingly acknowledged as a valuable adjunct vasopressor in catecholamine-resistant shock states. AVP is an excellent example of how an orphan drug can be developed to improve the treatment of our patients.

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## Research Training in Anesthesiology

### Expand It Now!

IN the January 2006 edition of *Anesthesiology*, an article<sup>1</sup> and accompanying editorial<sup>2</sup> proposed options to increase the number of physicians who wish to pursue clinical or basic science training during their residency or fellowship training. The ideas presented in these publications are interesting and thought provoking—and the options deserve additional comment because several of them currently are readily available to department chairs, program directors, fellows, and residents.

Debra A. Schwinn, M.D. (Professor, Departments of Anesthesiology and Pharmacology/Cancer Biology and Surgery, Duke University Medical Center, Durham, North Carolina), and Jeffrey R. Balsler, M.D., Ph.D. (Professor, Departments of Anesthesiology and Pharmacology, Vanderbilt University Medical Center, Nashville, Tennessee), note the past decade's depressing stagnation in anesthesiology-related research that is funded by the National Institutes of Health (Bethesda, Maryland) and propose three options that would help to improve this disturbing problem. First, they recommend expanding the number of anesthesiology subspecialties that have fellowships accredited by the Accreditation Council of Graduate Medical Education (ACGME).<sup>1</sup> Second, they plead for the leadership of the American Board of Anesthesiology (ABA) and the American Society of Anesthesiologists (ASA) to work with ACGME to lengthen and redesign accredited fellowships to include at least 1

yr of required research. Third, they advocate that the ABA reward graduates of subspecialty training programs that require at least 1 yr of research training with subspecialty certification.

Paul R. Knight, M.D., Ph.D. (Professor, Department of Anesthesiology, State University of New York, Buffalo, New York), and David C. Warltier, M.D., Ph.D. (Professor and Chair, Department of Anesthesiology, Medical College of Wisconsin, Milwaukee, Wisconsin), editorialize that it may be better to increase the exposure of residents, especially those who have pursued dual M.D.-Ph.D. degrees during medical school, to research during their residency training instead of waiting until the fellowship years.<sup>2</sup> They hypothesize that a major issue that prevents motivated residents from pursuing clinical or basic science research long-term is their inability to conduct research early in their anesthesiology training. The time gap created by required clinical experiences during residency training hinders these residents from reengaging in research activities at the end of their residency training. They plead for specialty leaders to develop an expanded 5-yr, research-intensive internship and residency training track that would allow motivated new physicians to be able to integrate research training throughout the entire training continuum, with up to half of the 5-yr postgraduate training period dedicated to research experiences. They offer a sample curriculum rotation for residents who might follow this track during postgraduate year (PGY)-1 through PGY-5.

This Editorial View accompanies the following seven letters and replies: Andreae MH: Integrate our international anesthesia research potential. *ANESTHESIOLOGY* 2006; 105:624; Gelman G: Anesthesiologist-scientist: Endangered species. *ANESTHESIOLOGY* 2006; 105:624-5; Pandit JJ: Royal College recommendations to improve academic anesthesia in the United Kingdom: How they compare with United States proposals. *ANESTHESIOLOGY* 2006; 105:625-6; Fleisher LA, Eckenhoff RG: Image not living up to goal. *ANESTHESIOLOGY* 2006; 105:626-7; Compagna JA: Academic anesthesia and M.D.-Ph.D.s. *ANESTHESIOLOGY* 2006; 105:627-8; Knight PR, Warltier DC: (Reply). *ANESTHESIOLOGY* 2006; 105:628; Balsler J, Schwinn DA: (Reply). *ANESTHESIOLOGY* 2006; 105:629-30.

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\* Current ACGME Transitional Year Program Requirements. Available at: [http://www.acgme.org/acWebsite/downloads/RRC\\_progReq/999pr703.pdf](http://www.acgme.org/acWebsite/downloads/RRC_progReq/999pr703.pdf). Accessed April 18, 2006.

† Current ACGME Anesthesiology Program Requirements. Available at: [http://www.acgme.org/acWebsite/downloads/RRC\\_progReq/040pr703\\_u804.pdf](http://www.acgme.org/acWebsite/downloads/RRC_progReq/040pr703_u804.pdf). Accessed April 18, 2006.

### What Currently Is Typical?

Gratifyingly, the ABA and the ACGME have current requirements and processes that readily accommodate several of the suggestions above. Residents in ACGME-approved anesthesiology training programs can spend as much as 6 of their 36 months of anesthesiology training (typically PGY-2 through PGY-4) in research activities that are integrated throughout their curriculums and meet all requirements for entrance into the examination system of the ABA at the conclusion of their training. In addition, new physicians who enter their specialty training through either a transition year program (*i.e.*, transition year or rotating internship)\* or the first year of a comprehensive 4-yr anesthesiology program (*i.e.*, clinical base year)† may take up to 2 months of that first year for research training. Thus, current requirements allow

up to 8 months of research integrated throughout the 48 months of experiences required for individuals to enter the ABA's examination system.

The primary limitation to even more research opportunity during the first 48 months of training is the ABA's examination entrance criteria. ‡The ACGME's anesthesiology program requirements allow programs considerable flexibility to offer electives, including research experiences, to their residents and have them integrated throughout their curriculums. † The current program requirements state only that residents must have 1-month experiences in the subspecialties of pediatric anesthesia, cardiothoracic anesthesia, obstetric anesthesia, and neuroanesthesia. They also must have 2 months of training in critical care medicine, 1 month in pain management, and 2 weeks of experience in a postoperative care unit. All other training experiences are left to the discretion of the programs, with the goal that all graduating residents achieve minimum clinical exposure to unique anesthetic techniques and types of patients and surgical or diagnostic procedures. The ACGME's anesthesiology program requirements will change in July 2008. §The new requirements state that residents will spend at least 16 months in various subspecialty rotations and that research experiences can occur at any time during their curriculums. Parenthetically, the ACGME's Transitional Year program requirements will change in July 2007. ||The change will not impact the current 2 months of research that is allowed in the transition year period.

In contrast, the ABA currently requires individual residents to complete (1) at least 10 months of clinical training during the PGY-1 experience and (2) at least 30 months of anesthesiology-related clinical training during the 36 months of clinical anesthesia year (CA)-1 through CA-3 (40 months of clinical experiences in total) to be granted entrance into its examination system. ‡ During the first 2 yr (CA-1 and CA-2), these months must include at least 12 months of basic anesthesia training; at least 7 months of subspecialty training in the disciplines of obstetric anesthesia, pediatric anesthesia, cardiothoracic anesthesia, neuroanesthesia, anesthesia for outpatient surgery, recovery room care, regional anesthesia, and pain medicine; and at least 2 months of critical care medicine training. During CA-3, at least 6 months must be spent by individual residents in advanced anesthesia (*i.e.*, clinical) training. The ABA will allow research experiences for individual residents to be integrated throughout their curriculums.

‡ American Board of Anesthesiology Booklet of Information. Available at: <http://home.theaba.org/materials/BOI-2005.pdf>. Accessed April 18, 2006.

§ ACGME Anesthesiology Program Requirements effective July 2008. Available at: [http://www.acgme.org/acWebsite/downloads/RRC\\_progReq/040pr708.pdf](http://www.acgme.org/acWebsite/downloads/RRC_progReq/040pr708.pdf). Accessed April 18, 2006.

|| ACGME Transitional Year Program Requirements effective July 2007. Available at: [http://www.acgme.org/acWebsite/downloads/RRC\\_progReq/999pr707.pdf](http://www.acgme.org/acWebsite/downloads/RRC_progReq/999pr707.pdf). Accessed April 18, 2006.

## What Currently Is Possible?

Here is the important information for program directors and residents who wish to incorporate additional research experience into their training curriculums: The ABA's Credentials Committee will consider requests for individual residents to gain experiences that fall outside of its requirements. For example, the ABA will consider individual-specific requests for training experiences that provide more research exposure and less clinical training. In addition, there is no specific ABA requirement that addresses the lengths of research experiences that residents are allowed to have integrated into their curriculums. The ABA generally wishes to avoid gaps of more than 6 months between clinical experiences. However, the committee will review requests for extraordinary curriculum or schedule variations and base judgments on whether the requested variations will provide the individual residents with balanced comprehensive curriculums and experiences that are necessary to become board-certified anesthesiologists.

Because neither the ACGME nor the ABA prevents residents from spending an extra year (*e.g.*, PGY-5) in training, we believe that the current ACGME anesthesiology program requirements and the ABA's criteria for entrance into its examination system allow program directors and dedicated residents to come close to matching the proposal from Drs. Knight and Warltier of having a 5-yr Anesthesiology Physician Scientist Pathway that allows 50% research time. The ABA examination entrance requirements allow at least 8 months of research in PGY-1 through PGY-4. Combined with the extra 12 months that would be available within a PGY-5 research experience, residents can obtain 20 months of research experience in a 5-yr period without requesting an exception from the ABA. However, the ABA will consider requests for individual-specific curriculums that allow more research experience during the PGY-1 through PGY-4 training period or throughout an expanded 5-yr curriculum. The ABA will also consider requests to allow research experiences to be integrated throughout an expanded 5-yr curriculum.

Here is one approach for program directors to consider if they wish to integrate more research experience into 5-yr curriculums of one or more individual residents in their programs:

- Assuming that their institutions would allow extension of resident training from 4 to 5 postgraduate years for specific individuals (and its requisite funding), program directors would need to confer with their interested medical students or residents, ensure that strong mentors would be available for each, and design proposed curriculums that would integrate research into a 5-yr training period. These curriculums must, of course, also meet ACGME (program) requirements and

ABA (individual) criteria for minimum clinical experiences.

- If program directors wished to expand these opportunities by regularly offering extended positions for integrated research and clinical training, they could contact the ACGME and propose innovative programs that would more permanently expand their programs' number of approved residents.¶The Anesthesiology Resident Review Committee will review these requests promptly.
- The program directors would then contact the ABA and ask for reviews of their proposed curriculums, seeking prospective approvals. If approval of one or more individual PGY-5 training experiences would result in programs needing temporary approval of one or more positions from ACGME to accommodate the extensions, the program directors could notify the ACGME and ask for temporary expansion of their programs' approved positions.

### What Needs to Be Discussed Further—and Quickly?

Several of the issues raised in the January article and editorial need further discussion within the anesthesiology community.

First, Drs. Schwinn and Balsler recommend expanding the number of anesthesiology specialties that have fellowships accredited by the ACGME. The ACGME's Anesthesiology Residency Review Committee recently endorsed accreditation of fellowship training in cardiothoracic anesthesiology. The ACGME agreed, and applications for accreditation of training programs in this subspecialty are now available on the ACGME Web site.¶¶ The Resident Review Committee also has been informed that it will likely receive a request for accreditation of subspecialty training in obstetric anesthesiology in 2006.

Second, these same authors wish to extend subspecialty fellowship training to at least 2 yr and require a year of research during the training period. During the past several years, this idea has been preliminarily discussed in a number of venues, including retreats attended by representatives from the ASA, ABA, Resident Review Committee, Foundation for Anesthesia Education and Research, Society for Academic Anesthesiology Chairs, and Academic Anesthesiology Program Directors. To date, no consensus has been reached on this issue. Notably, there are no ACGME or ABA requirements that prevent individual programs from offering

extended fellowship training and requiring their fellows to have at least 1 yr of research experience.

Third, Drs. Schwinn and Balsler advocate that the ABA reward graduates of extended subspecialty fellowship programs with certification. Currently, the ABA offers certification only in the subspecialties of pain and critical care medicine. The ABA has a policy in place to consider subcertification in additional disciplines. It will accept proposals for subcertification from major national subspecialty societies that have seats in the ASA House of Delegates and from other entities that represent subspecialty groups. Because of the need to ensure that a solid basis and need for subcertification exists, disciplines that have ACGME-accredited training programs will be preferentially considered. A description of the process for applying for certification in an anesthesiology subspecialty is available from the ABA.

Last, Drs. Knight and Warltier have proposed an anesthesiology physician scientist training pathway that would make 30 of the 60 months in a 5-yr curriculum available for research experience. Currently, a 60-month curriculum will allow individual residents to enter the ABA's examination system with 20 months of research experience. The ABA's Credentials Committee will, however, consider requests for exceptions that would allow more research opportunities in expanded curriculums.

### Summary

The specialty is well served by the questions and proposals raised by the authors of these two important publications. We believe current ACGME program requirements and ABA criteria for entering its examination system, along with ACGME and ABA interests in accommodating well-designed, exceptional curriculums on a case-by-case basis, allow individual residents and program directors to craft personalized curriculums that can provide strong research-oriented training experiences and be integrated throughout anesthesiology training programs. Proposals to further expand research experiences during residency training or to require dedicated research time in anesthesiology subspecialty training programs will be debated further in the coming year.

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¶ ACGME Anesthesiology RRC procedure for submitting experimentation or innovative proposals. Available at: [http://www.acgme.org/acWebsite/RRC\\_040/040\\_proSubProposals.asp](http://www.acgme.org/acWebsite/RRC_040/040_proSubProposals.asp). Accessed April 18, 2006.

¶¶ Available at: <http://www.acgme.org>. Accessed July 28, 2006.